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Earth Observing System

Data Product Specification for the MISR Level 3 Joint Aerosol Product

-Incorporating the Science Data Processing Interface Control Document

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Multi-angle Imaging SpectroRadiometer (MISR)

Data Product Specification for the MISR Level 3 Joint Aerosol Product

-Incorporating the Science Data Processing Interface Control Document

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To determine the latest released version of this document, consult the MISR web site (http://misr.jpl.nasa.gov).

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Document Change Log

Revision	Date	Affected Portions and Description
	28 September, 2012	All, original release

Which Product Versions Does this Document Cover?

Product Filename Prefix	Version Number in Filename	Brief Description
MISR_AM1_JOINT_AS	F01_0001	Level 3 Joint Aerosol

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1 INTRODUCTION

1.1 MISR LEVEL 3 JOINT AEROSOL PRODUCT

The Multi-angle Imaging SpectroRadiometer (MISR) Level 3 Joint Aerosol (JOINT_AS) product contains global statistical summaries of MISR Level 2 aerosol optical depth, on a 5 degree geographic grid. Within each grid cell, optical depth is summarized by a set of representative vectors, each representing a cluster of similar Level-2 aerosol optical depth retrievals. Data is summarized monthly.

The purpose of this document is to describe the format of the MISR JOINT_AS product. The full details of the other MISR standard products, as well as the ancillary datasets used in their generation, can be found in their respective MISR Data Product Specifications Documents (and for earlier versions of the products in the MISR Data Products Specifications Document, Rev S). Information concerning the MISR georegistration is contained in the MISR Science Data Product Guide.

1.2 MISR DATA PRODUCTS

The MISR project is a component of the Earth Observing System (EOS) Terra Mission and the EOS Data and Information System (EOSDIS), which are components of the National Aeronautics and Space Administration's (NASA) Earth Science Enterprise. An integral part of the MISR project is the Science Data Processing (SDP) of the observations coming from the MISR instrument on-board the EOS Terra satellite.

MISR SDP exists to produce science and supporting data products from MISR instrument data. All functions of the MISR SDP system are directed toward this goal. MISR SDP does not operate as an independent entity, but rather is linked to the functionality of the EOSDIS at the Langley Research Center (LaRC) Distributed Active Archive Center (DAAC). The EOSDIS Core System (ECS) ingest subsystem at the LaRC DAAC is the agent for receiving and organizing all of the input data needed by MISR SDP. These data are then made available to MISR SDP through the data server and staging facilities provided by ECS at the LaRC DAAC. After MISR standard data processing is complete, the standard output products are archived through the EOSDIS data server and made available to users through ECS client services.

The MISR Science Computing Facility (SCF) at the Jet Propulsion Laboratory (JPL) supports the development of MISR science algorithms and software, instrument calibration and performance assessment, as well as providing quality assessment and data validation services with respect to MISR SDP. The MISR SCF is used to produce software, supporting data, and coefficients that are required to operate MISR SDP software at the LaRC DAAC.

MISR SDP depends upon the availability of MISR instrument data, internal data sets produced at the MISR SCF, and external data sets that are products of other EOS data processing systems.

1.3 CONTROLLING DOCUMENTS

1) MISR Data System Science Requirements, JPL D-11398, September 1996 (or latest version).
2) MISR Level 1 Radiance Scaling and Conditioning Algorithm Theoretical Basis, JPL D-11507, Revision D, January 1999 (or latest version).
3) MISR Level 1 Georectification and Registration Algorithm Theoretical Basis, JPL D-11532, Revision B, August 1996 (or latest version).
4) MISR Level 1 Cloud Detection Algorithm Theoretical Basis, JPL D-13397, Revision A, November 1997 (or latest version).
5) MISR Level 1 In-flight Radiometric Calibration and Characterization Algorithm Theoretical Basis, JPL D-13398, June 1996 (or latest version).
6) MISR Level 1 Ancillary Geographic Product Algorithm Theoretical Basis, JPL D-13400, Revision B, March 1999 (or latest version).
7) MISR Level 2 Aerosol Retrieval Algorithm Theoretical Basis, JPL D-11400, Revision G, March 10, 2008 (or latest version).
8) MISR Level 2 Ancillary Products and Datasets Algorithm Theoretical Basis, JPL D-13402, Revision A, December 1998 (or latest version).
9) MISR Science Data Product Guide, JPL D-73355, April 2012 (or latest version).

APPLICABLE DOCUMENTS

10) SDP Toolkit Users Guide for the ECS Project, HAIS 194-809-SD4-001 (or latest version)

2 MISR LEVEL 3 JOINT AEROSOL DATA PRODUCT SPECIFICATION

2.1 MISR JOINT_AS PRODUCT GRANULE NAMES

MISR JOINT_AS product granules are reported monthly.

Table 1 – JOINT_AS Product Granule Names

MISR JOINT_AS Product Granule Name[1]	ESDT Name
MISR_AM1_JOINT_AS_ mmm_yyyy_Fff_vvvv.hdf	MI3MJTA

2.2 MISR JOINT_AS PRODUCT FILE FORMAT

Each MISR JOINT_AS product granule consists of a Hierarchical Data Format (HDF) file providing a statistical summary of the MISR Level 2 aerosol optical depth retrievals on a 5 degree geographic grid. The time period of a granule is one month, corresponding to the standard calendar months. Orbits overlapping adjacent months are assigned to the month in which the orbit starts. The precise set of orbits used in a granule is also explicitly given in the granule metadata. Although the data is logically located in a regular 5 by 5 degree geographic grid, there are no map-like structures within the file. Rather, geolocation is explicitly given by latitude and longitude columns in the vdatas.

2.2.1 Dimensions

Table 2 - Dimension sizes.

Name	Size	Description
NParticle, NParticle1, NParticle2	8	Number of component particles .
NCluster	variable	Number of clusters in Aerosol Clusters Vdata.

2.2.2 Grid cells

Each 5 x 5 degree grid cell contains zero or more clusters. The Grid cells Vdata gives the location, number of clusters, mean squared error, and entropy for grid cells containing at least

1 “mmm” is the three-character month (one of “JAN”, “FEB”, “MAR”, “APR”, “MAY”, “JUN”, “JUL”, “AUG”, “SEP”, “OCT”, “NOV”, “DEC”), “yyyy” is the four-digit year (e.g., “2002”), “ff” is the format version number (e.g. “01”), and “vvvv” is the data version number (e.g., “0001”).

one cluster. Grid cells containing no clusters (i.e. no Level-2 input data available) are omitted from the Vdata.

Table 3 – Grid cells Vdata

Column Name	Type	Size	Description
Latitude	float64	1	Latitude at center of this grid cell.
Longitude	float64	1	Longitude at center of this grid cell.
ClusterCount	int32	1	Number of clusters in this grid cell.
ClusterMeanSqError	float32	1	Unconditional mean squared error of clusters in this grid cell.
NormalizedClusterMeanSqError	float32	1	Unconditional mean squared error of normalized clusters in this grid cell.
ClusterEntropy	float32	1	Entropy of the distribution defined by clusters in this grid cell.

2.2.3 Aerosol clusters

The Aerosol clusters Vdata contains a record for each cluster. Covariance matrices associated with each cluster are available in separate SDS structures, shown in Table 5. The NCluster dimension of the covariance SDS is equivalent to the record index of the Aerosol clusters Vdata.

Table 4 – Aerosol clusters Vdata

Column Name	Type	Size	Description
Latitude	float64	1	Latitude at center of grid cell containing this cluster.
Longitude	float64	1	Longitude at center of grid cell containing this cluster.
Weight	int32	1	Number of Level-2 aerosol optical depth retrievals represented by this cluster.
Distortion	float32	1	Measure of agreement between the representative vector and its associated cluster of Level-2 aerosol optical depths.
NormalizedDistortion	float32	1	Measure of agreement between the normalized representative vector and its associated cluster of normalized Level-2 aerosol optical depths.
OpticalDepthComponentParticle	float32	NParticle	Representative vector.
NormalizedOpticalDepth ComponentParticle	float32	NParticle	Normalized representative vector.

Table 5 – SDS structures containing covariance associated with aerosol clusters.

Column Name	Type	Dimensions	Description
Covariance	float32	NCluster, NParticle1, NParticle2	Covariance for the Level-2 vectors assigned to the cluster.
NormalizedCovariance	float32	NCluster, NParticle1, NParticle2	Covariance for the normalized Level-2 vectors assigned to the cluster.

2.2.4 Metadata

Normalization of cluster parameters requires aggregate statistics of aerosol optical depth accumulated over a multiple year time span. These aggregate statistics are provided by SDS structures in Table 6.

Table 6 – SDS structures containing normalization statistics.

SDS Name	Type	Dimensions	Description
GrandMean	float32	NParticle	Mean of aerosol optical depth over multiple year time span.
GrandStDev	float32	NParticle	Standard deviation of aerosol optical depth over multiple year time span.
GrandCount	uint32	NParticle	Count of aerosol optical depth vectors contributing to GrandMean.
GrandCovariance	float32	NParticle1, NParticle2	Covariance of aerosol optical depth over multiple year time span.

The Component Particle Vdata identifies the particles associated with the NParticles dimension.

Table 7 – Component Particles Vdata

Column Name	Type	Size	Description
ComponentParticleNumber	int32	1	Component particle number from the Ancillary Climatology Product
ComponentParticleName	char	80	Component particle name.

Parameters that control the clustering algorithm are given in the following file attributes.

Table 8 - File attributes

Attribute Name	Type	Size	Description
Resolution.latitude	float64	1	Grid cell size along latitude axis. (degrees)
Resolution.longitude	float64	1	Grid cell size along longitude axis. (degrees)
Algorithm.iterations	int32	1	Number of iterations of clustering algorithm
Algorithm.lambda	float32	1	Lambda value used by clustering algorithm
Algorithm.max_clusters	int32	1	Maximum number of clusters allowed per grid cell.
Algorithm.epsilon	float32	1	Epsilon value used by clustering algorithm.

The Source file Vdata contains a list of MISR Level-2 input data sets used to generate this granule. This list **does not** include the multiple years of input data sets contributing to the normalization statistics in Table 6.

Table 9 – Source file Vdata

Column Name	Type	Size	Description
Orbit number	int32	1	Orbit number
Path number	uint8	1	Orbit path number
Local Granule Id	char	80	ECS local granule identifier for the Level-2 Aerosol Product
Local Version Id	char	100	Version identifier of software that generated the Level-2 Aerosol product.

3 Appendix

3.1 Acronym List

AGP ..... Ancillary Geographic Product
DAAC .....Distributed Active Archive Center
DID ..... DTED Intermediate Dataset
DTED ..... Digital Terrain Elevation Dataset
ECS .....EOSDIS Core System (Data Production System at DAAC)
EOS .....Earth Observing System
EOSDIS .....Earth Observing System Data and Information System
ESDT.....Earth Science Data Type
HDF-EOS ..... Hierarchical Data Format for EOS
JPL .....Jet Propulsion Laboratory
LaRC DAAC.....NASA Langley Research Center DAAC
MISR.....Multi-angle Imaging SpectroRadiometer
NASA.....National Aeronautics and Space Administration
SCF .....Science Computing Facility
SDP .....Science Data Processing
SDS ..... Scientific Data Set
SOM.....Space-Oblique Mercator
TAI ..... Temps Atomique International (International Atomic Time)
TC .....Top-Of-Atmosphere and Cloud
TOA .....Top-Of-Atmosphere
UTC ..... Coordinated Universal Time
WGS84.....World Geodetic System 1984